

# International Astronautical Federation Specialist Symposium

## Market-Based Systems for Science Planning

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### ABSTRACT

Of the many space related things history can record, the observations executed by a deep space mission and their science interpretation is an obvious choice. However, the process for determining which observation requests should be incorporated into spacecraft command files has been anything but historic. Past processes can be summarized by the Principal Investigators first submitting their requests to an educated third party who decides which observations are in, which get moved or shortened, and which are left out. This is followed by integration meetings to discuss the results; and numerous appeals to try to change the results.

A new innovative approach for science planning has been developed which is based on the market forces of supply and demand. These market-based systems have many appealing characteristics. They allow the Principal Investigators, who have the most at stake, to decide which observations are in and which are out. This removes the need for a third party to make these difficult decisions. Market-based systems also remove the need to have update meetings to inform the Principal Investigators about the results made by the third party; it also removes the need for integration meeting at which investigators argue the merits of including one investigator's requests over another. In addition, the system resides on the Internet which makes the process compatible with distributed operations and allows Principal Investigators to interact with the system from their home institution, conferences, or from any other location, provided they have access to the Internet.

Market-based systems were first successfully applied to space missions during the development of the instrument payload for the international Cassini mission to Saturn. The extraordinary results from this application show that for Cassini's payload, the cost during development grew by only +1%, and the mass by -7%. To date, market-based approaches for the allocation of spacecraft resources have also been applied experimentally to manifesting Space Shuttle secondary payloads, science planning for the radar mission called LightSAR, and science planning for Cassini's tour about Saturn.

This paper will discuss the many benefits of a market-based science planning system. It will describe how experimental economics is used to validate market-based systems, show results from experiments performed for both LightSAR & Cassini science planning, and will show that the process requires less workforce and time to generate a conflict-free spacecraft command file. A market-based system also promotes synergistic observation, as two investigators can pool their resources to express a greater demand for time on the timeline as compared to "going it alone." Finally, market-based science planning processes are compatible with nominal ground systems. This allows results from the Internet to be directly downloaded into the Project's sequence generation software system.